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Software tool for time evolution of EBIS/EBIT charge breeding in the radial (transverse) approximation*

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We present a software tool that is capable of following the radial (transverse) time evolution of charge breeding in EBIS/EBIT devices. The underlying assumption is that the longitudinal (parallel) dynamics is largely decoupled from the transverse dynamics, an assumption which is valid after a short initial "equilibration" transition. The extra information that such simulation provides includes radial (transverse) distributions of charge, field, and velocity, transverse temperature; and includes space charge effects, fractional overlap between ions and electron beam, particle losses to the radial wall, and other diagnostic information.

What makes such (1D) simulations more practical is the utilization of a newly developed, general energy-conserving particle algorithm [1]. It allows to relax the stringent condition that relates the numerical grid size to the simulation time step in the traditional particle-in-cell (PIC) method and to also use a minimal number of computational particles. These properties provide the critical computational advantage for the energy-conserving method and make long time (tens of miliseconds) charge breeding numerical simulations possible on a single multi-core desktop station.

[1] E. G. Evstatiev and B. A. Shadwick. "Variational formulation of particle algorithms for kinetic plasma simulations." JCP **245**, 376-398 (2013).